INSTRUCTION MANUAL
for
LINEARCORDER MARK VII
WR3101

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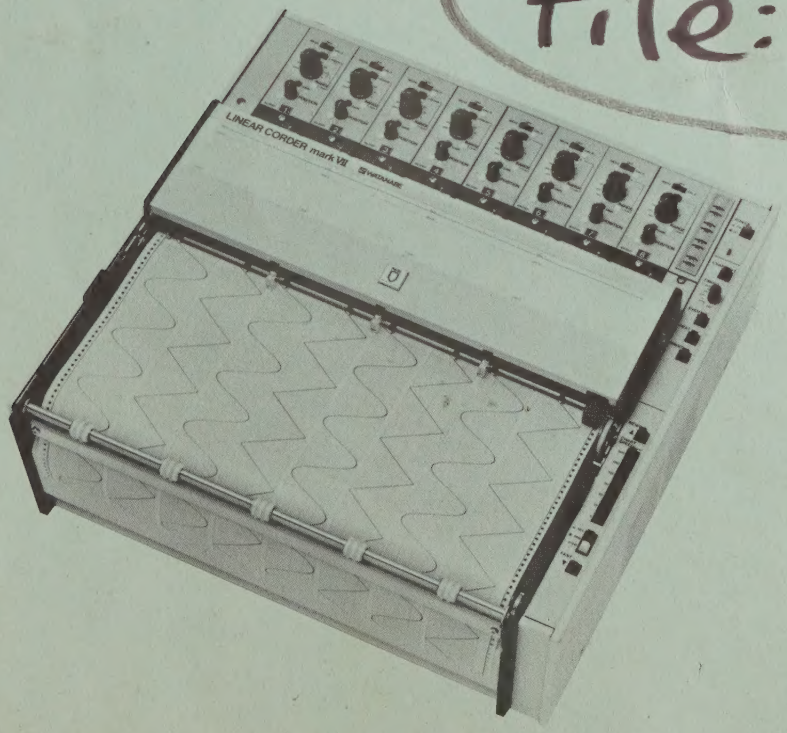


WATANABE INSTRUMENTS CORP.
TOKYO,JAPAN

CONTENTS

1 Nomenclature and Functions ---- 2

1-1 Top View ---- 2
1-2 View of Underside ---- 2
1-3 View of Rear Panel (Including Input Terminals) ---- 2
1-4 Power Supply Switch; S. W. Switch ---- 4
1-5 Control Panel ---- 5
1-6 Recording Paper Advance ---- 7
1-7 Preamplifiers ---- 8
1-8 Pen Motors and Markers ---- 10

2 Preparing for Operation ---- 12

2-1 Inserting the Recording Paper ---- 12
2-2 Connecting the Power Supply ---- 16
2-3 Connecting the Input Lines ---- 17
2-4 Adjusting the Noise Filter ---- 21

3 Measurement and Recording ---- 22

3-1 Recording of Waveforms ---- 22
3-2 Operating the Markers ---- 23
3-3 Operating the Printer ---- 24
3-4 Precautions ---- 28

4 Control by External Signals ---- 29

4-1 Control of Recording Operation ---- 29
4-2 Printing from External Equipment ---- 31

5 Specifications ---- 35

5-1 Main Unit Specifications ---- 35
5-2 Preamplifier Specifications ---- 37
5-3 Accessories ---- 38

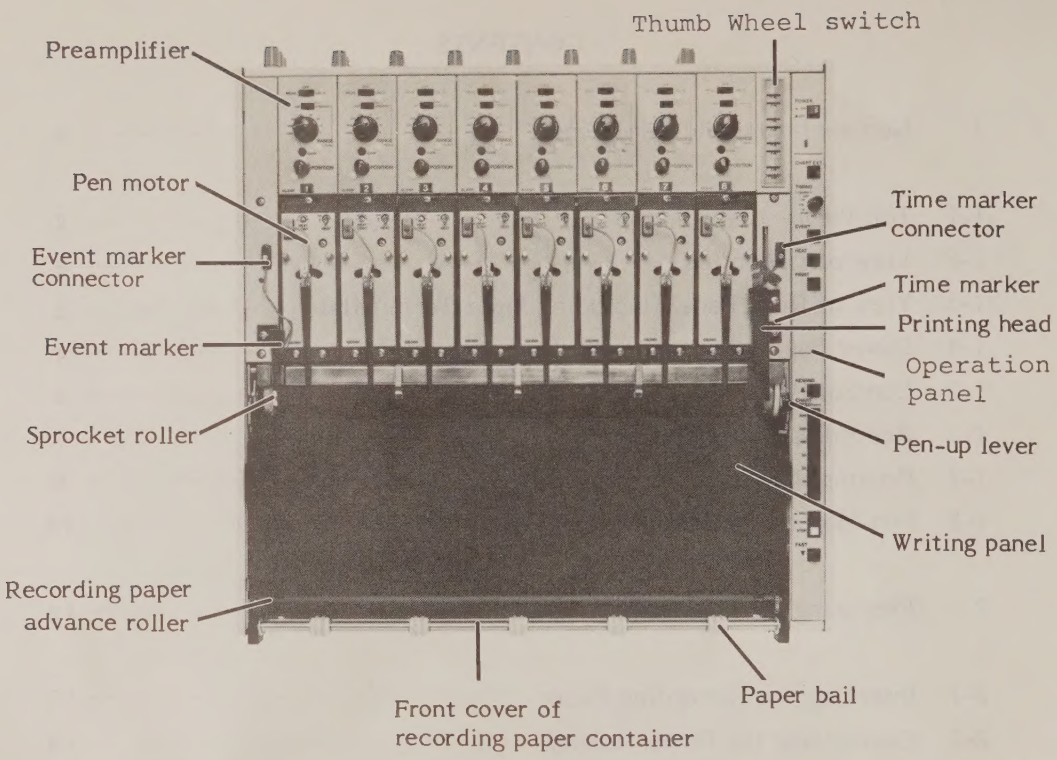


Fig. 1-1 Photograph of top

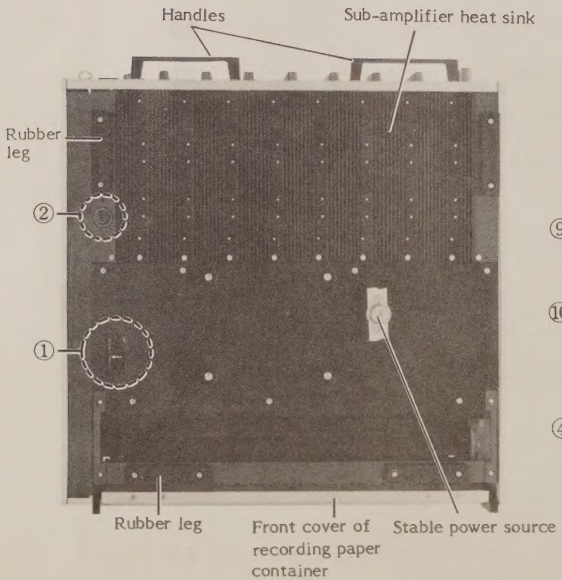


Fig. 1-2 Photograph of underside

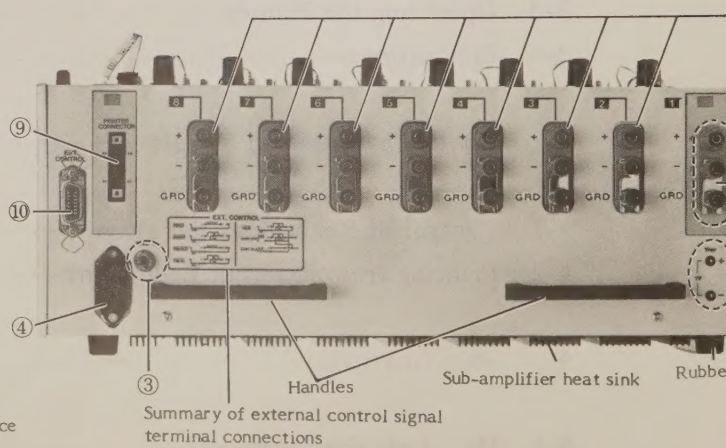


Fig. 1-3 Photograph of rear panel

1 Nomenclature and Functions

1-1 Top View

Fig. 1 - 1 is a photograph of the top of the WR 3101 Linearcorder Mark VII.

The main features are 8 channel pen motors and preamplifiers. There are also the markers and the print head which has the control panel next to it. Underneath the paper bail on the recording panel is a concertina lid which can be easily pulled out to cover the unit.

1-2 View of Underside

Fig. 1 - 2 is a photograph of the view from below the unit and shows the power supply selector and fuses. Due consideration should be given to the fact that this underside is the heat sink for the recorder.

1) Power supply selector

Setting the central white line to the appropriate number will adjust the unit's power supply voltage. A mistake in this setting is very dangerous.

2) Fuses

These can be easily removed by inserting a Philips screwdriver and turning it counterclockwise.

1-3 View of Rear Panel (Including Input Terminals)

Fig. 1 - 3 shows a photograph of the unit's rear panel. All external connections are made here.

3) Grounding terminal

A grounding cable should be connected to this terminal to earth those metal parts of the unit such as the casing which may be touched. Apart from the casing, the grounding cable is also connected internally to the earth on the power supply plug and to the neutral line of the secondary coil in the main transformer.

4) Power supply socket

This socket is for three pronged plugs with the earth terminal in the centre. Only the power supply cord which comes with the unit should be used.

5) Standard voltage output terminals

The potential of the black terminal is the same as that of the negative input terminal, from the red, output is +1 V $\pm$0.2%. When calibrating the preamplifier's sensitivity, an output resistance of 200Ω should be applied.

6) Input terminal: Channel 1 (conditioner)

The input to channel 1 passes through the conditioner to the preamplifiers. The black GRD is the guard terminal, the red minus is the floating earth, and the red plus is the input terminal for the positive side of the signal. The input plug coming with the unit can be used.

7) Input terminals: Channels 2 - 8

These terminals are connected directly to the preamplifier input of the corresponding channel. The functions of the black GRD and the red plus and minus are the same as those of channel 1.

8) Shorting bars

The use of these metal pieces between the black GRD and the red negative terminals is explained in section 2.3.3.

9) Printer unit input plug

This plug is the input for character signals coming from an external keyboard source which operates the printer. A detailed explanation of the terminal array and so on appears in section 2-3-3.

10) External control signal plug

This plug is used when operating the paper advance, pen heating or the markers etc. by external signals. Its use is explained in detail in section 4-1.

1-4 Power Supply Switch; Thumb Wheel switch. (See Fig. 1-4)

11) POWER ON/OFF switch

This is the switch for the overall power supply to the recorder. If it is pressed once, the button remains depressed in the ON position. Pressing it once more returns it to the raised OFF position.

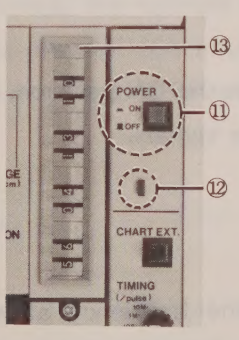


Fig. 1-4 Power supply switch and Thumb Wheel switch

12) ON/OFF lamp (red)

This lamp lights up when there is power being supplied to the recorder.

13) Thumb Wheel switch

This is an eight digit switch which determines data no., the day, month and year and the initial value of the seconds, minutes and hours which will be printed. Its use is explained in section 3-3.

PRECAUTIONS

1) The correct setting of the power supply selector is extremely important. Of primary importance is the confirmation of the voltage of the power supply. Passing power of an inappropriate voltage through the recorder will result in permanent damage. Please make sure that the setting is correct.

2) When the recorder is connected to a power source which does not have a grounding cable, it is imperative that a grounding conductor be attached to the ground terminal.

1-5 Control Panel (See Fig. 1-5)

14) CHART EXT

This switch, when in the ON position, causes the paper advance to be operated by external pulse signals.

15) TIMING dial

This dial changes the frequency at which the signals operating the time marker are generated. At the settings 10 m, 1 m, 10 s, 1 s, timing pulses are generated at internals of, respectively, 10 mins, 1 min, 10 secs and 1 sec. The length of these marker signals are approximately 7, 4, 0.7 and 0.2 secs respectively. These signals can also be sent out of the unit through the external control signal plug (10). At the STOP setting the timing pulses are stopped, and at the EXT setting external signals are sent to the markers. The length of these marker signals is 0.7 secs.

16) EVENT switch

This switch operates the event marker. When it is depressed, the marker will draw a mark line.

17) HEAT switch

When this switch is in the raised position, there is no power passing to any of the the heat pens. Power will pass to the heat pens if this switch is depressed and all other switches are at the appropriate settings for heat pen operation.

18) PRINT switch

Printing is only possible if this switch is depressed to the ON position and all other switches are set in the appropriate positions for heat pen operation.

19) REWIND switch

While this switch is pressed, the current to the heat pen is stopped and the paper roll rewinds at a speed of 100 mm/sec. This operation is only possible when using paper rolls. (The STOP switch must be in the STOP position.)

20) CHART SPEED switches

These buttons determine the speed at which the paper advances. There are seven speeds: 5, 10, 25, 50, 100, 250 and 500 mm/min or sec. If none of the buttons are depressed, the paper will advance at 5 mm/min or sec.

21) Sec/min switch

This switch sets the time unit (either minutes or seconds) for the recording paper advance.

22) STOP switch

When this is locked in the down position, the recording paper will not advance, the pen will be released and there will be no power passing to the heat pens.

23) FAST switch

Depressing this switch advances the recording paper at its maximum speed (500 mm/sec).

1-6 Recording Paper Advance

Apart from those described above, the WR3101 Linearcorder also has operating switches for the paper advance as shown in Fig. 1-6.

24) Paper roll - folded paper selection switch

In order to deal with the large inertia load when paper rolls are used at high speeds, different circuits are necessary from those used in the case of folded paper. Moreover, folded paper cannot be rewound. The change over to those driving circuits is carried out by this switch.

25) Pen-up lever

When this lever is pulled forward, the gears on the paper roller and the drive motor are disengaged, and the paper roller can therefore be freely rotated. If, while this lever is raised, the STOP switch is released a buzzer will sound, the pen will not make contact, and no recording will take place.

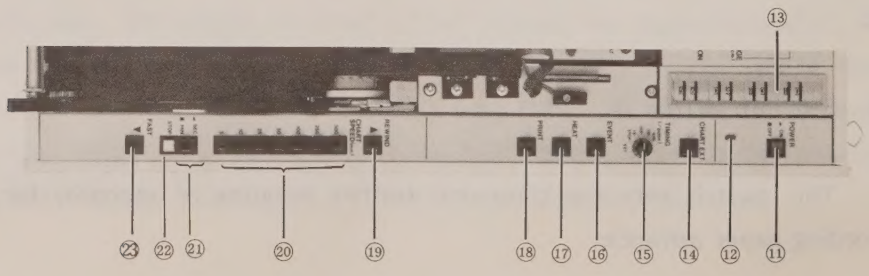


Fig. 1-5 Control Panel

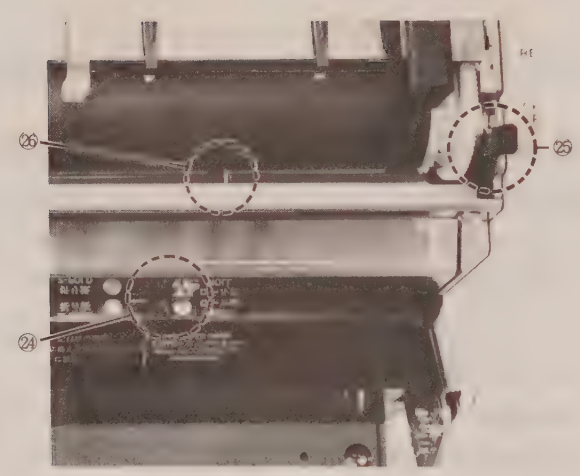


Fig. 1-6 Paper Advance Switches

26) Recording paper gauge

A switch operates when the recording paper is not inserted properly. A buzzer will sound when this switch operates.

1-7 Preamplifiers (See Fig. 1-7)

These handle the accurate amplifications of the input voltage, and generate the input signals for the pen motor servo amplifier.

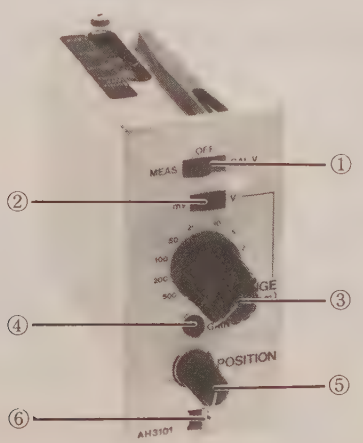


Fig. 1-7 Preamplifier

1) MEAS/OFF/CAL.V switch

When this switch is turned to the OFF position, the amplifier circuitry switches from the input terminal to the ground, thus breaking contact with the external input as a step in the preparation for recording. At the MEAS setting the input enters the amplifier circuitry.

Turning the switch to CAL.V changes the amplifier input to ground. As a result of the internal voltage the pen will oscillate through 20 mm in the AL 3101 and the AH 3101, and for 40 mm in the AL 3102 and the AH 3102. This oscillation width varies according to the setting of the GAIN knob which will be described later.

2) mV/V (mV/x100mV)

When this switch is set at V (x100mV) the input section's potential divider decreases the voltage input to the amplifier circuits to 1/1,000 (1/100) V. At the mV setting the voltage input is not decreased.

3) RANGE dial

In the case of the AH3101 preamplifier, there are 9 settings: 1, 2, 5, 10, 20, 50, 100, 200, 500/cm. If the mV/V switch is set at mV, and this dial is, for instance, set at 5 (/cm), the deflection sensitivity of the pen will be 1 cm at 5 mV. However, this sensitivity is also influenced by the GAIN knob.

4) GAIN vernier knob

This is used when interpolating between the step changes in sensitivity which are determined by the RANGE dial settings. Turning the knob to the right increases the sensitivity, while it is decreased by turning the knob to the left. If, when the MEAS/OFF/CAL.V switch is changed from OFF to CAL.V, adjustments are made so that the pen will oscillate over 20 mm (in the AL 3101 and AH 3101) and over 40 mm (in the AL 3102 and AH 3102), the sensitivity will be that of the RANGE dial setting.

5) POSITION knob

This knob is used to determine the pen's zero setting. When the input voltage is zero, it is possible to set the pen's position manually over the full scale.

6) Channel no. plate

The channel number appears on this plate. However, if it is moved to the left (can be done using a finger nail) a screw can be seen. Removal of this screw allows the preamplifier to be taken out.

1-8 Pen Motors and Markers

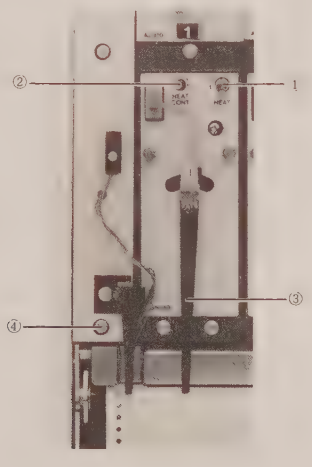


Fig. 1-8 Pen motor and marker

1) HEAT switch

When this switch is turned off, power to the heat pen is stopped and the input to the servo amplifier is grounded, breaking connection with the preamplifier. It is used when adjusting the position of the pen after replacement.

2) Heater control

This regulates the amount of current passing to the heater of the heat pen. Turning it clockwise makes the recording line heavier, counterclockwise makes the line thinner.

3) Heat pen

In the tip of the pen is an extremely small heater which generates heat immediately when electric current passes through it, for recording on heat sensitive paper.

4) Event marker (time marker)

In the tip of the pen are two heaters. Normally, the heater on the side of the paper which has the sprocket holes is on, if the event marker pen is then switched on, and records event marks. The time marker on the other side of the unit performs in the same manner. These pens do not move.

2 Preparing for Operation

2-1 Inserting the Recording Paper

2-1-1 Recording paper

Recording paper for the WR3101 comes in roll and folded paper. Both types are in lengths of 100 meters but vary according to the width of pen oscillation and the number of channels used. When the heaters in the tips of the pens are heated they record in either black or blue.

1) The color generated by the pens differs greatly according to the color generation intensity used and the finish of the recording paper.

2) The charts may change color or fade due to the influence of ultraviolet rays, or if stored in direct sunlight or at a high temperature.

3) The recording paper will react to vinyl chloride, diazotized copying, acid and alcohol, so please bear in mind the following precautions.

PRECAUTIONS

1) Please use the recording paper manufactured by this company only.

2) Please refrain from storing or using the recording paper and charts under extreme environmental conditions.

3) Please refrain from placing the recording paper on top of equipment which generates heat or from putting it together with blue-prints in plastic bags.

2-1-2 Paper roll loading

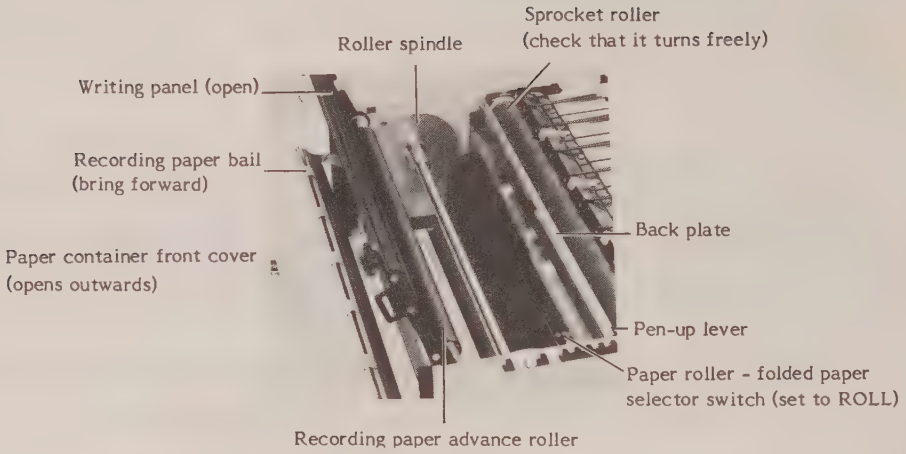


Fig. 2-1 Preparations for inserting recording paper

Load the paper roll following these steps:

1) Open the writing panel and the front cover. Gripping the spindle in both hands and keeping it in a horizontal position lift it upwards. Ensure that the sprocket wheel is on the right (see Fig. 2-1).

2) Set the paper roll - fold paper selector switch to ROLL.

3) Insert the spindle into the paper roll paying attention to the following points:

4) Turn the spindle around and remove the flange on the end without the sprocket wheel by turning it counterclockwise with the right hand.
Next, insert the spindle into the tube in the middle of the paper roll making sure that the cut mark on the side of the paper roll is at the flange end of the spindle, and that the pin on the spindle engages with the cut mark. Check that there is a nut showing at the other end of the roll, then tightly screw the flange back onto the spindle.

Finally, insert the roll into the paper container, making sure that the sprocket wheel is on the right hand side. (support with the left hand as shown in Fig. 2-2.)

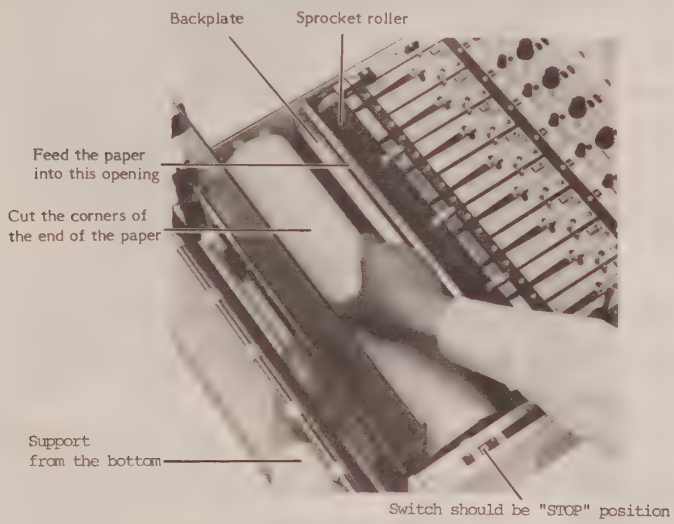

Backplate
Sprocket roller
Feed the paper into this opening
Cut the corners of the end of the paper
Support from the bottom
Switch should be "STOP" position

Fig. 2-2 Loading the paper roll

2-1-3 Folded paper loading

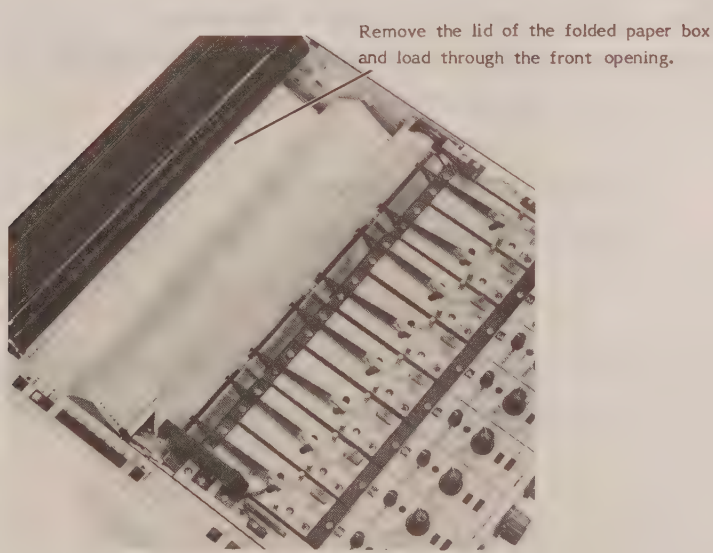


Fig. 2-3 Folded paper loading

Note: Ensure that the paper roll - folded paper selector switch is set at Z HOLD.

1) As shown in Fig. 2-1, open the paper container and remove the roller spindle (unnecessary with folded paper).

2) Set the paper roll - folded paper selector switch to Z HOLD.

3) Open the lid of the folded paper box, and load as shown in Fig. 2-3. (Insert the paper so that channel 1 is on the left hand side.)

2-1-4 Setting the recording paper

1) Pull forward the pen-up lever on the right of the unit, and check that the sprocket roller turns freely. Pulling the paper with both hands, pass it over the back plate and feed it under the roller. When the edge of the paper appears between the roller and the tips of the pens, grip it and draw it forward and up. Carefully align the perforations in the paper onto the sprockets by moving the left hand sprocket wheel from side to side. Pull the paper through for several centimeters then return the pen-up lever to its original position. (See Fig. 2-4.)

2) After replacing the writing panel, line the paper up on top of it, then lift the paper bail forward and feed the paper underneath it.

3) Return the paper bail to its original position.

Note The paper should be loaded only when the STOP switch on the recorder is turned to STOP.

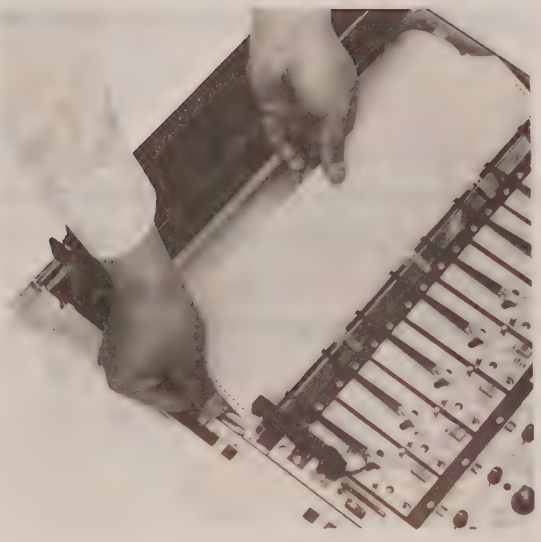


Fig. 2-4 Pulling out the paper

2-2 Connecting the Power Supply

1) When connecting the power supply initially, first ensure that the power supply selector is set correctly, then check to see that all other switches are set according to the following:

Control panel:	CHART EXT: OFF, HEAT: OFF
	CHART STOP: STOP
Preamplifier:	MEAS/OFF/CAL.V: OFF
Pen motors:	HEAT ON/OFF: OFF

2) Plug in the power supply cord. If there is no protective grounding on the power supply, do not forget to attach a grounding cable to the ground terminal.

3) Turn the POWER ON/OFF switch to ON. The ON/OFF lamp will light up (red) and the pen will move slightly but then return to its original position.

4) Set the CHART.SPEED to a suitable speed and test the paper advance.

5) Next turn the HEAT ON/OFF switch ON, and at a slow speed release the CHART STOP button. Check that when the preamplifier POSITION switch is moved the pen also moves.

6) Lastly, turn the HEAT switch on the control panel to ON and check that the pen draws a line.

2-3 Connecting the Input Lines

2-3-1 Preparations

1) Switches should be at the following settings.

Control panel: POWER ON/OFF: ON
CHART EXT: OFF
TIMING: arbitrary
HEAT: OFF, PRINT: OFF
CHART SPEED: 5 mm/sec, STOP: STOP

Preamplifier: MEAS/OFF: OFF, RANGE: arbitrary
mV/V (mV/x100mV): V(x100mV)

Pen motors: HEAT ON/OFF: OFF

2) Ensure that there is no potential difference by measuring the voltage across the gap between the guard terminal ground (shielded) or the input signal source and the ground terminal of the WR3101. If such a difference appears clearly on a voltmeter (AC), do not proceed with the connection, but find the cause and rectify it.

3) Using another method (e. g. a cathode-ray tube oscillograph) check the input wave form to ensure that it does not exceed 500V peak to peak, and that high frequency noise is not excessive.

4) Remove the shorting bars if the mode of input necessitates it.

2-3-2 Connecting the input cord

The input signal connections can only be made using the input cord provided, and these should be attached as shown in Fig. 2-5. This input cord is a shielded cable, if a different type of cable is used, noise can result. The plugs on the input cord (as well as those on the other end of the cord which have not yet been explained) are connected as follows: red to the positive terminal, white to the negative terminal and the shielded line to the ground terminal.

WARNING

If the plugs are inserted upside down while the shorting bars are removed, the signal source equipment will be short-circuited.

The connections to the signal source are normally carried out with the shorting bars in place. The negative and GRD terminals are connected to the signal source ground and positive is connected to the output of the signal source. However, as is explained in the following, this is not the correct method.

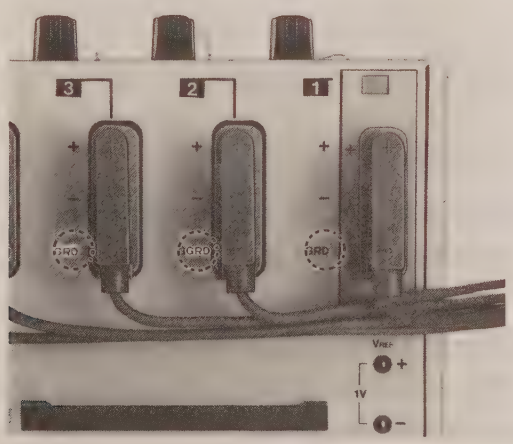
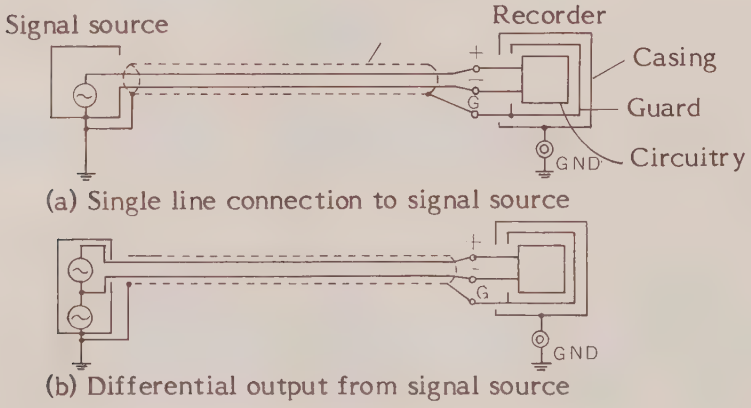


Fig. 2-5 Connecting input lines

2-3-3 Use of the guard terminals

(a) Principle of guards

The guard terminal is connected to the guard on the ground terminal of the signal source through the input lines' shielded cable. If it is necessary to let the shielded cable drop to a ground terminal, in principle, this should be done at the signal source. This would produce an ideal screening effect for the input system, since the grounding occurs at one point of the signal source output. (See Fig. 2-6.)



(a) Single line connection to signal source

(b) Differential output from signal source

Fig. 2-6 Strict usage of guards

Explanatory notes: What is the guard?

The guards insulates the main units' casing from the metal casing enclosing the electronic circuitry of the conditioners, preamplifiers and so on. Further, it is connected to the guard on the input equipment through the shielded cable of the input line. This has the same effect as wrapping the whole amplifying circuit (signal source - input cord - recorder) in a metal shield. This is a means of preventing noise which inevitably arises when measuring minute voltages with high impedance.

When the signal source output is high and the impedance across the ground is low, (that is, when measuring the output of equipment powered by dry cells and other such routine measurements) the guard is not so important.

(b) Guard at times of normal measurement

Fig. 2-7 shows the methods of such measurements. However, these are, strictly speaking, shortcuts. Thus, when noise is a real problem, the correct procedure should be followed.

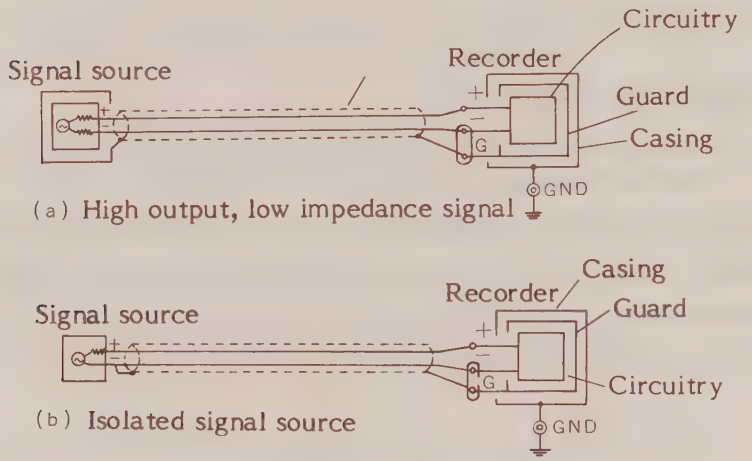


Fig. 2-7 Normal Connections

2-3-4 Connections not using the input cord

Please note the following cautionary points when not using the input cord.

1) The positive and negative signal wires should pass along a common route. This will lead to a cancelling of noise such as hum arising in both wires. In turn this will activate a common mode rejection effect in the preamplifier.

2) If the input cord's shielded cable is used as the connection between the signal source equipment and the recorder's grounding terminal, hum currents will flow along the shielded cable and become the cause of noise interference. In order that contact voltages and hum currents be excluded an insulated shield should be used (e.g. the input cord which is an accessory to the unit).

3) When measuring high impedance and low output, there can arise due to the oscillation of the input wire, a frictional voltage which cannot be overlooked. Further, if wire made from a different metal is inadvertently used to lengthen the input cord, drift will occur due to temperature differences.

2-4 Adjusting the Noise Filter

If a preamplifier is removed, a 50-60 Hz switch (in the AH 3101 and AH 3102) will be seen as is shown in Fig. 2-8. By adjusting this switch to the frequency of the power source noise resulting from hum will be reduced by 99%. However, these filters are only effective for signal components over a level of several Hz.

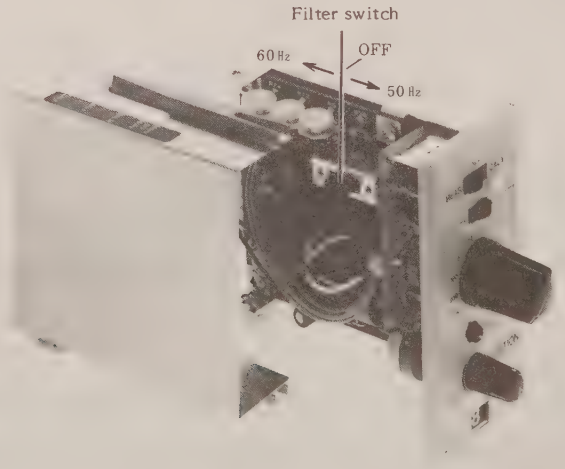


Fig. 2-8 Filter switch

3 Measurement and Recording

3-1 Recording of Waveforms

3-1-1 Simple plotting of the input waveforms

The precedure for merely observing the waveforms without using the printer or markers is as follows:

1) Set the switches on the control panel to the following:

CHART.EXT: OFF, TIMING (/PULSE): STOP, HEAT: OFF, PRINT: OFF, CHART SPEED: 50 mm/MIN, STOP: STOP

Also turn the MEAS/OFF switch on the preamplifier to OFF.

2) Turn the POWER ON/OFF to ON and set the ON/OFF switch on the pen motor of the channel to be used to ON. Release the paper advance STOP. The paper will begin advancing at a speed of 50 mm/min. and the pen can now be adjusted by the POSITION knob.

3) Turn the POSITION knob to set the pen to an appropriate starting position. Switch the MEAS/OFF to MEAS and the pen will move in response to the input signal.

4) Use the RANGE dial and the mV/V (mV/x100mV) switch to gradually increase the sensitivity until an appropriate amplitude is found.

5) Next, turn the CHART SPEED to the desired speed and immediately turn on the HEAT switch. Recording will now begin.

6) When necessary, turn the HEAT CONT. volume on the pen motor to adjust the thickness of the trace.

CAUTION: At first, when the characteristics of the input are not known, begin adjustment of the sensitivity from the lowest level.

3-1-2 Fine adjustment and calibration of the sensitivity

1) Interpolation between the settings on the RANGE dial can be carried out by turning the GAIN knob during operation of the recorder. This allows fine adjustments to the sensitivity.

2) To calibrate the amplitude, proceed as follows. After setting the MEAS/OFF/CAL.V. switch to OFF, position the pen on the zero line, then switch back to CAL.V. The pen oscillates over a width equipment to twice (four times) the RANGE voltage.

3) When accurate calibration of the amplitude is desired first set the RANGE to 500 mV/cm (for the AL 3101 and AH 3101) or 250 mV/cm (for the AL 3102 and AH 3102). Then switch the input to the standard voltage output terminal on the rear panel and turn the GAIN knob so that the pens oscillate over 20 mm or 40 mm respectively.

3-2 Operating the Markers

3-2-1 The event marker

While the EVENT switch on the control panel is depressed, recording is done on the mark side.

3-2-2 The time marker

Set the TIMING dial on the control panel to the desired frequency of marking.

The first stroke of the time marker begins with HEAT ON. At whatever setting whether HEAT OFF, REW, or STOP, marking takes place, since the HEAT OFF setting occurs momentarily the first stroke will be duplicated.

During recording, changing the TIMING (/PULSE) or the CHART SPEED or operating the FAST advance will not duplicate the first stroke.

Fig. 3-1 shows an example of a marker chart.

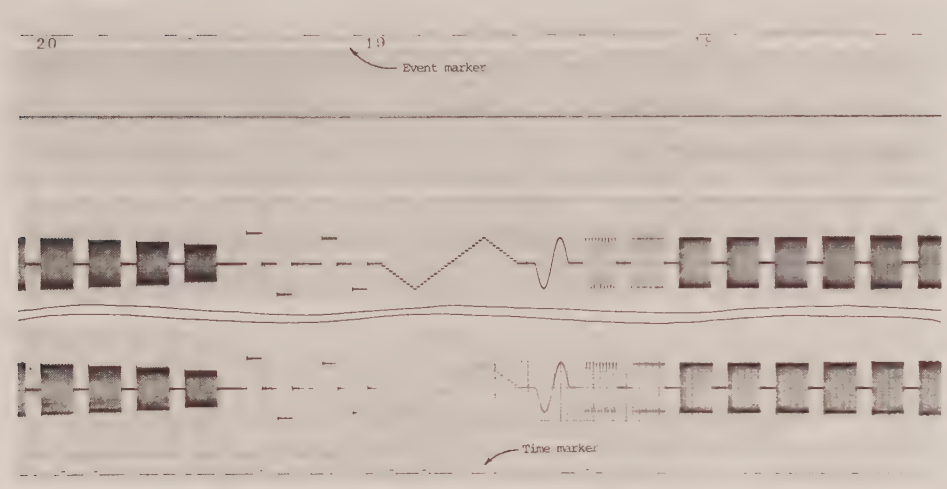


Fig. 3-1 An example of a marker chart

3-3 Operating the Printer

3-3-1 Characteristics of the printer

1) The computer controlling the printer will be cleared only at POWER OFF.

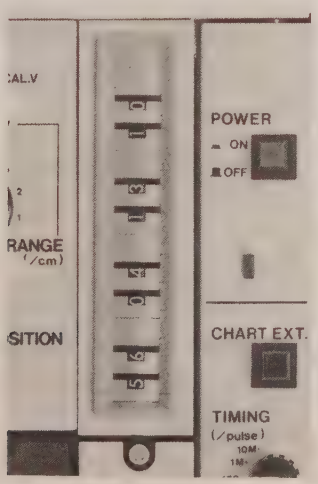


Fig. 3-2 S. W. switch

2) If all the digits in the Thumb Wheel switch are set to 9, all the internal characters will be repeated and printed out.

3) Printing is carried out when the PRINT and HEAT switches are set to ON, and the paper advance STOP released.

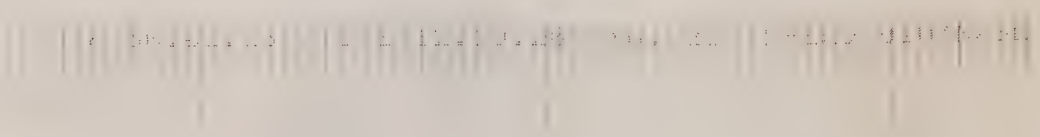
4) There are two modes to the printing operation, an internal and an external mode. The former prints digital information input from the T.W. switch, while the latter prints character information input from external digital equipment.

5) Print-out of the internal mode takes place promptly after the recording paper has begun advancing and the processing of the data is completed. Thereafter, it occurs approximately every 450 mm. However, at paper advance speeds of over 250 mm/sec, printing occurs at approximately every 900 mm.

6) Print-out of the external mode begins immediately. However, if print-out of the internal mode is taking place, external input will be stored and printed following the completion of the internal mode print-out.

7) An external input of a character string should be finished with CR/LF.

8) The time and CHART SPEED printed out when in the internal mode is the time and CHART SPEED when the printing begins.



Printing example

Fig. 3-3 Example of internal mode print-out

3-3-2 Establishing the internal mode 1

This procedure prints out the date (year, month, day), the length of the operating period, the data number, and the speed of the recording paper advance.

1) The length of the operating period begins at 00 hours 00 mins 00 secs when the unit is turned on, and continues accumulating while the unit is operating.

2) When the length of the operating period exceeds 24 hours, the calculation begins again from 00 hours 00 mins 00 secs.

Operating procedure

1) Starting from the left side, set date (year, month, day) and data number on the Thumb Wheel switch.

Example: '81 - 4 - 13, Data No 10, would be set as,

81 04 13 10.

2) POWER switch: ON.

3) HEAT switch, PRINT switch: ON.

4) Set the CHART SPEED switch
Example: 50 mm/sec.

The above would be printed out as follows.

DATE 81. 04. 13. TIME 00. 00. 01
No. 10 SPEED 050 MM/sec

Note The content of the print-out is the data which immediately precedes the printing of DATE ..... Since data cannot be

updated during printing, if an update does occur, it should be entered into the following internal mode data.

3-3-3 Establishing the internal mode 2

This procedure prints out the data (year, month, day), the time, the data number and the speed of the recording paper advance.

Operating procedure

1) STOP switch: ON, PRINT switch: OFF.

2) POWER switch: ON.

3) Set the two digits on the left side of the T. W. switch at 90, and the remaining 6 digits at the time (hour, mins, secs).

Example: 10. 15. 00 would be set as,

90 10 15 00

Note Changes to the T. W. switch described below should start from the extreme left hand side.

4) Set the 9 at the left of the switch to 0. This reads the hours, minutes and seconds into the circuit.

5) Set the two far left digits to 91. The remaining six digits should be set to the date (year, month, day).

Example: '81 - 4 - 13 would be set as,

91 81 04 13

6) Change the far left digit to 0.

7) Set the two far left digits to 92 and the two far right digits to the data number.

8) Change the far left digit back to 0.

9) Set the CHART SPEED switch. Example: 50 mm/sec.

10) PRINT switch, HEAT switch: ON.

The above would be printed out as follows:

DATE 81. 04. 13 TIME 10. 15. 01
No. 10 SPEED 50 MM/sec

Note If the data number is changed after this, that new number will be printed out.

3-4 Precautions

The unit's heat pens are sensitive to extreme heat. If any of the following conditions should arise, turn the HEAT switch to OFF immediately and isolate the fault.

a) The pulse motor locks.

If, while using folded paper, the paper jams in the container and the motor is unable to draw it out the motor will lock. The motor can also lock when the FAST switch (23) is set in the Z FOLD position and the paper roll is being advanced at its maximum speed. When the motor does lock it oscillates loudly then stops. However, the pens continue to be heated.

b) When the CHART EXT switch is ON, the pens move even if there is no external signal being sent. While the paper advance is not being operated, the pens continue to be heated.

c) The pen tips will also overheat if the paper advance speed is slowed down and the thickness of the line is not reduced after the paper advance has been operating at a very high speed, causing a too thick line.

4 Control by External Signals

4-1 Control of Recording Operation

4-1-1 Control Items

This Linearcorder can carry out the following operations in accordance with external signals:

1) Paper advance by pulse string
2) Time marking by timing pulses
3) Event marking by event signals
4) HEAT ON/OFF control
5) CHART START/STOP control

Moreover, the following information can be sent to external equipment:

6) Recording paper end signal
7) Internal timing pulse

4-1-2 Arrangement of socket terminals and their signals

Fig. 4-1 is a diagram of the terminals of the external signal input sockets and their relationship to input and output signals.

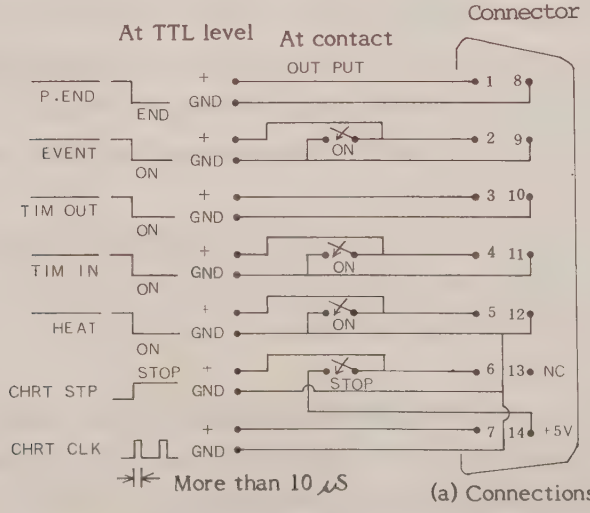


Fig. 4-1 External Control Terminals

Table 4-1 External Control Signals

Signal name	Input/output	Operation
$\overline{\text{P. END}}$	Output	LOW (level TTL) by pen up or when recording paper ended.
$\overline{\text{EVENT}}$	Input	Short to GND or event marking by LOW (level TTL).
$\overline{\text{TIM OUT}}$	Output	LOW (level TTL) when timing marking.
$\overline{\text{TIM IN}}$	Input	Short to GND or timing marking by LOW (level TTL).
$\overline{\text{HEAT}}$	Input	Short to GND or pen heater ON by LOW (level TTL).
CHRT STP	Input	Short to +5V (No. 14) or end paper advance by High (level TTL).
CHRT CLK	Input	Paper advance by pulse.

4-1-3 Relationship to internal control

1) Recording paper external advance: switched by CHART EXT ON/OFF.

2) Timing marking: switched by TIMING (/PULSE) dial.

3) Event marking: internal EVENT switch and OR.

4) HEAT ON/OFF: OFF and OR (ON is AND)

5) CHART START/STOP: STOP or OR (START is AND)

6) Warning signals: output when recording paper ends or pen up.

7) Timing pulses: output only when CHART EXT is OFF.

4-1-4 Precautions when under external control

1) As explained above, the pen may overheat, and thus the pen heater be damaged, when it is moved by an ON setting of the CHART EXT if there is no recording paper advance signal being sent.

2) The maximum frequency of the pulses being sent to the external equipment is 2 KHz. Thus, since one pulse advances the paper 0.025 mm, a maximum speed of 50 mm/sec is reached.

3) Low level TTL signals can be substituted for the signals at the contacts shown in Fig. 4-1.

4) For timing marking, the pulse is fixed at 0.7 secs and is unrelated to the speed of recording paper advance.

4-2 Printing from External Equipment

4-2-1 Interface

The printer interface of the WR3101 is an 8 bit system conforming to the ASCII.

The connector pins' numbers appear in Fig. 4-2. The timechart is shown in Fig. 4-3. Input is at TTL level.

B		A
BUSY	8	DATA 0
$\overline{\text{ACK}}$	7	DATA 1
N.C	6	DATA 2
GND	5	DATA 3
GND	4	DATA 4
BUSY	3	DATA 5
DATA 7	2	DATA 6
N.C	1	$\overline{\text{STB}}$

Fig. 4-2 Printer Connectors

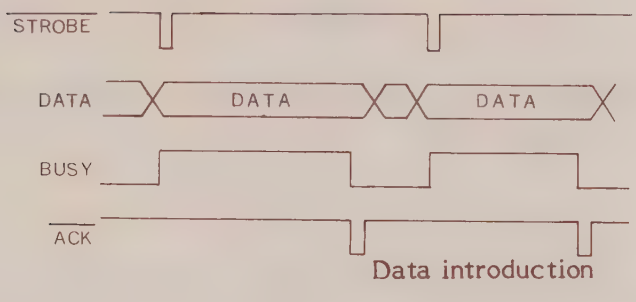


Fig. 4-3 Timechart for Delivery and Receipt of External Mode Signals

4-2-2 General operation

For input of character signals either according to the ASCII or a Kana code, the procedure shown in Fig. 4-4 should be followed. The characters should be temporarily stored, then printed in one string as the paper advances.

4-2-3 Illustrative examples

The flowchart above is explained by the following concrete example.

1) _____/(term):
18 characters

The buffer receives twelve characters and as soon as it is FULL, these twelve characters are printed out. The remaining six characters are received and these too are printed out.

2) _____/ (term):
less than 11 characters

The characters up to the terminator are printed out.

3) _____/(no term):
13 - 23 characters

First, the initial twelve characters are printed out. The remainder simply go into the buffer memory and are neither printed out nor printed in the internal mode.

4) _____ (no term):
less than 12 characters

The data is received in the buffer memory but it is neither printed out nor printed in the internal mode.

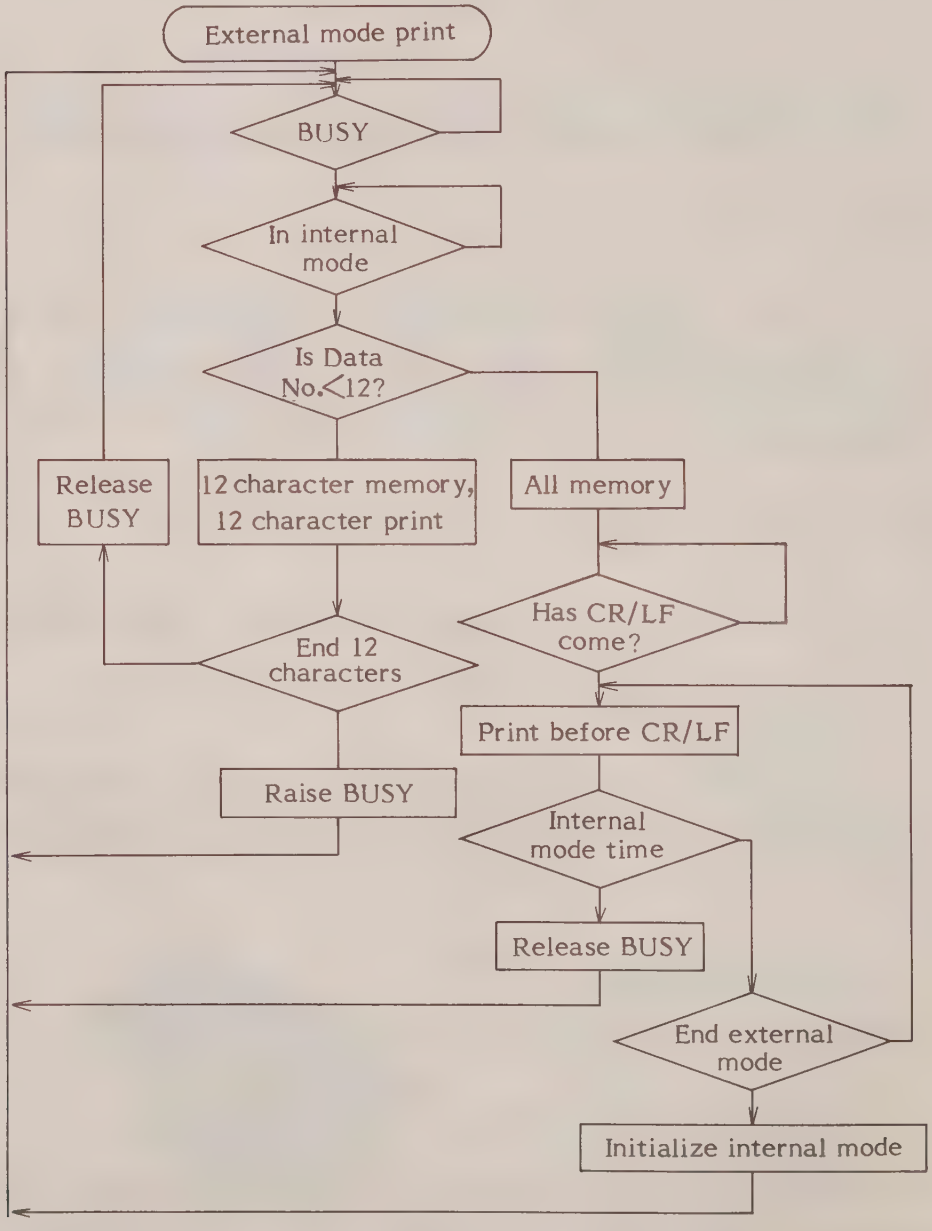


Fig. 4-4 External Mode Printing

4-2-4 Code Chart

The code chart for the WR3101 printer appears in chart 4-2.

Chart 4-2 Code chart

row / column	00	···	02	03	04	05	···	11	12	13	···
0	NUL		SP	0	@	P		−	タ	ミ	
1	TC_1 (SOH)		!	1	A	Q		ア	チ	ム	
2	TC_2 (STX)		〃	2	B	R		イ	ツ	メ	
3	TC_3 (ETX)		#	3	C	S		ウ	テ	モ	
4	TC_4 (EOT)		$	4	D	T		エ	ト	ヤ	
5	TC_5 (ENQ)		%	5	E	U		オ	ナ	ユ	
6	TC_6 (ACK)		&	6	F	V		カ	ニ	ヨ	
7	BEL		'	7	G	W		キ	ヌ	ラ	
8	FE_0 (BS)		(	8	H	X		ク	ネ	リ	
9	FE_1 (HT)		)	9	I	Y		ケ	ノ	ル	
10	FE_2 (LF)		*	:	J	Z		コ	ハ	レ	
11	FE_3 (VT)		+	;	K	[		サ	ヒ	ロ	
12	FE_4 (FF)		,	<	L	¥		シ	フ	ワ	
13	FE_5 (CR)		−	=	M	]		ス	ヘ	ン	
14			.	>	N	↑		セ	ホ	゛	
15			/	?	O	←		ソ	マ	゜	

1 All column 00 are processed as terminators.

5 Specifications

5-1 Main unit

Item \ Model	Model GS3101	Model GW3101
Channel numbers	2.4.6.8.12	1.2.3.4.6
Amplitude of recording	±20 mm	±40 mm
Method of recording	Heat pen (black or blue color generating)	
Input mode	Floating with guard shield	
Circuit mode	DC-servo type	
Input resistance	1 MΩconstant (At preamp. equipped)	
Sensitivity	±2.5V/20 mm	±2.5V/40 mm
Accuracy	Within ±0.5% over the full scale (including linear deviation and dead zone.)	
Frequency response (with 1 Hz standard)	10 mm p-p: 0-120 Hz (+5.-10%) 20 mm p-p: 0-80 Hz (+5.-10%) 40 mm p-p: 0-55 Hz (+5.-10%)	20 mm p-p: 0-60 Hz (+5.-10%) 40 mm p-p: 0-45 Hz (+5.-10%) 80 mm p-p: 0-30 Hz (+5.-10%)
Standard voltage	1 V (accuracy ±0.2%)	
Paper advance speeds	5.10.25.50.100.250.500 mm/sec or min and EXT (50 mm/sec MAX) (accuracy ±0.2% ±0.5 mm)	
Time marker	Mark every 1.10 sec or 1.10 min (accuracy ±0.1%), also, remote operation possible by TTL level or short-circuit of the external contacts.	
Event marker	Operated by a push button; also, remote	

	operation possible by TTL level or short-circuit of the external contacts.			
Remote control of recording paper advance	Remote ON-OFF possible by TTL level or short-circuit of the external contacts.			
Remote control of pen heaters	Remote ON-OFF possible by TTL level or short-circuit of the external contacts.			
Recording paper rewind	100 mm/sec (only possible on paper roll type)			
Printout	Date; time (period of time); data number, "button-in clock circuit" which prints the speed of the recording paper advance; "Centronics" which prints the desired numbers, symbols and Kana in the ASCII and Kana codes input from external equipment.			
Required power supply	100 VAC(117.220.240 V selector attached) ±10%; voltage determined by channel 1 (in model GW3010) and channel 2 (GS3101) (50 - 60 Hz common use).			
Power consumption (approximate) LH: 10 mm p-p at 120 Hz DL(DH): 20mm p-p at 60 Hz	2L(H)	4L(H)	6L(H)	8L(H)
	185 VA	245 VA	305 VA	365 VA
	12L(H)	1DL(DH)	2DL(DH)	3DL(DH)
	485 VA	155 VA	185 VA	215 VA
	4DL(DH)	6DL(DH)		
	245 VA	305 VA		
Dimensions (mm) (error margin: ±3 mm)	W: 430 H: 187 (common to both models)			
	199(D)	289(D)	379(D)	450(D)
	649(D)	199(D)	289(D)	379(D)
	450(D)	649(D)		
Weight (approximate)	13 kg	18 kg	24 kg	28 kg
	41 kg	12 kg	16 kg	20 kg
	23 kg	34 kg		
Range of temperature tolerance	0°C - 45°C			

Range of humidity tolerance	30 - 85% R.H.

*1. The larger power consumption includes that for the preamplifiers.

5-2 Preamplifiers

Item \ Type	AL3101	AL3102	AH3101	AH3102
Maximum sensitivity	5 mV/cm	2.5 mV/cm	1 mV/cm	0.5 mV/cm
Measurement range (switching accuracy)	5. 10. 20. 50. 100. 200. 500. 1000 mV 0.5. 1. 2. 5. 10. 20. 50. 100 V/cm	2.5. 5. 10. 25. 50. 100. 250. 500 mV 0.25. 0.5. 1. 2.5. 5. 10. 25. 50. 100 V/cm	1. 2. 5. 10. 20. 50. 100. 200. 500 mV 1. 2. 5. 10. 20. 50. 100. 200. 500 V/cm	0.5. 1. 2.5. 5. 10. 25. 50. 100. 250 mV 0.5. 1. 2.5. 5. 10. 25. 50. 100. 250 V/cm
	±1% (standard range 500V/cm)	±1% (standard range 250mV/cm)	±1% (standard range 500mV/cm)	±1% (standard range 250mV/cm)
Input mode	Guard-shielded floating earth			
Input resistance	Fixed at 1 MΩ			
Maximum permitted input voltage	DC 500 V (including in-phase voltage)			
Sensitivity adjustment	Continuous within the measurement range.			
Calibration voltage	Twice the measurement range (20 mm)	Four times the measurement range (40 mm)	Twice the measurement range (20 mm)	Four times the measurement range (40 mm)

Pen positioning	Arbitrary positioning possible over the full scale.			
Common mode rejection ratio	DC: 130 dB. AC: 110 dB			
Input filter			Built in (50 Hz, 60 Hz, OFF switch change-over, frequency response when ON: 0 - 5 Hz).	
Combined pen motors	GS3101	GW3101	GS3101	GW3101

5-3 Accessories

Part name	Quantity	Part name	Quantity
Instruction manual	1	Accessories bag	1
Recording paper	1	Power supply cord	1
Input cords	Equivalent to the number of channels	Fuses: 4A(2-6) 6A(8-12) 100V 117V 2A(2-6) 3A(8-12) 220V 240V	2
Plastic cover	1	Printing connector	1
Philips screwdriver	1	Remote connector	1
Flat blade screwdriver	1	Calibration signal cord	1
L-shaped fixed wrench	1		

Certificate of Inspection Results

This machine, by passing the strictest quality supervision and severest inspections, has proved that the efficiency of its method gives satisfaction. Further, inspection shows that it performs stably in conditions of high temperature and humidity.

Inspector

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